Introduction to Engineering Design					
Course Description					
Introduction to Engineering DesignTM (IED) is a high school level course that is appropriate for 9th or 10th grade students who are interested in design and engineering. The major focus of the IED course is to expose students to design process, research and analysis, teamwork, communication methods, global and human impacts, engineering standards, and technical documentation. IED gives students the opportunity to develop skills and understanding of course concepts through activity-, project-, and problem-based (APPB) learning. Used in combination with a teaming approach, APPB-learning challenges students to continually hone their interpersonal skills, creative abilities and understanding of the design process. It also allows students to develop strategies to enable and direct their own learning, which is the ultimate goal of education.					
Program of Study to which the course applies	**Course Code**				
STEM- Engineering PLTW-IED	100161				
	Course Content	**Reference Standards**	**Crosswalk to Common Core Standards**	**Crosswalk to Nebraska Standards**	**Comments**
Standard 1	Students will be introduced to the basics of the design process.	PLTW-IED			
Benchmark 1.1	Describe the various design processes that guide professionals in developing solutions to problems.	PLTW-IED	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a SC.12.1.3.e	When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).

Sample Performance Indicator 1.1.1	Apply engineering notebook standards and protocols when documenting their work during the school year.	PLTW-IED			
Sample Performance Indicator 1.1.2	Identify and apply group brainstorming techniques and the rules associated with brainstorming.	PLTW-IED			
Benchmark 1.2	Students will use the design process most used by engineers, including defining a problem, brainstorming, researching, identifying requirements, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype, testing, refining, making, and	PLTW-IED	ELA.WHST.11–12.4 ELA.WHST.11-12.7-9 ELA.SL.11-12.2 ELA.SL.11-12.5	LA.12.1.6.j LA.12.2.1.a LA.12.2.2.a LA.12.3.1.a LA.12.4.1.a-c SC.12.1.3.a SC.12.1.3.b SC.12.1.3.c SC.12.1.3.d SC.12.1.3.e	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7–9; NE: LA.12.1.6.j, LA.12.4.1.a–c).
Sample Performance Indicator 1.2.1	Research a product's history, develop a PowerPoint presentation, list chronologically the major innovations to a product, and present findings to a group	PLTW-IED			
Benchmark 1.3	Develop brainstorming techniques in groups/teams to generate large numbers of ideas in short time periods	PLTW-IED	ELA.11–12.SL.1	LA.12.3.3 SC.12.1.3.a	

Sample Performance Indicator 1.3.1	Research a product's history, develop a PowerPoint presentation, list chronologically the major innovations to a product, and present findings to a group.	PLTW-IED			
Sample Performance Indicator 1.3.2	Use online and published works to research aspects of design problems.	PLTW-IED			
Benchmark 1.4	Students will conduct research to develop their knowledge base, stimulate creative ideas, and make informed decisions.	PLTW-IED	ELA.WHST.11-12.7-9	LA.12.1.6.j LA.12.4.1.a-c	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7–9; NE: LA.12.1.6.j, LA.12.4.1.a–c).
Sample Performance Indicator 1.4.1	Use online and published works to research aspects of design problems.	PLTW-IED			
sample Performance Indicator 1.4.2	Research a product's history, develop a PowerPoint presentation, list chronologically the major innovations to a product, and present findings to a group.	PLTW-IED			
Benchmark 1.5	Students will use an engineer's notebook to chronologically document all aspects of a design project.	PLTW-IED	ELA.WHST.11-12.4 ELA.WHST.11-12.10	LA.12.2.2 SC.12.1.3.e	

Sample Performance Indicator 1.5.1	Apply engineering notebook standards and protocols when documenting their work during the school year.	PLTW-IED			
sample Performance Indicator 1.5.2	Use online and published works to research aspects of design problems.	PLTW-IED			
sample Performance Indicator 1.5.3	Identify the design process steps used in given scenarios and be able to list the steps, if any are missing.	PLTW-IED			
Standard 2	Student will demonstrate basic technical sketching and drawing	PLTW-IED			
Benchmark 2.1	Create sketches to quickly record, communicate, and investigate ideas.	PLTW-IED	ELA.WHST.11-12.6 ELA.SL.11-12.5 MTH.G.MG.3	LA.12.2.1.f LA.12.3.1.c MA.12.2.4.a	
Sample Performance Indicator 2.1.1	Identify, sketch, and explain the function of points, construction lines, object lines, and hidden lines	PLTW-IED			
Sample Performance Indicator 2.1.2	Plot points on grid paper to aid in the creation of sketches and drawings.	PLTW-IED			
Sample Performance Indicator 2.1.3	Explain the concepts of technical sketching and drawing.	PLTW-IED			

Benchmark 2.2	Apply pictorials and tonal shading techniques used in combination to give sketched objects a realistic look.	PLTW-IED	MTH.G.MG.3	MA.12.2.4.a	
Sample Performance Indicator 2.2.1	Explain the concepts of technical sketching and drawing.	PLTW-IED			
Benchmark 2.3	Design using isometric, oblique, perspective, and multiview sketching to maintain an object's visual proportions.	PLTW-IED	ELA.RST.11-12.3 MTH.G.MG.3	LA.12.1.6.k LA.12.3.2 MA.12.2.4.a	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 2.3.1	Sketch an isometric view of simple geometric solids.	PLTW-IED			
Sample Performance Indicator 2.3.2	Explain how an oblique view of simple geometric solids differs from an isometric view.	PLTW-IED			
Sample Performance Indicator 2.3.3	Sketch one-point, two-point, and three-point perspectives of simple geometric solids.	PLTW-IED			
Benchmark 2.4	Illustrate a multiview projection, which is the most common method of communicating the shape and size of an object that is intended for manufacturing	PLTW-IED	ELA.RST.11-12.3 MTH.G.MG.3	LA.12.1.6.k LA.12.3.2 MA.12.2.4.a	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 2.4.1	Sketch multiview drawings of simple geometric solids.	PLTW-IED			

sample Performance Indicator 2.4.2	Determine the front view for a given object.	PLTW-IED			
Standard 3	Students will apply measurement and statistics	PLTW-IED			
Benchmark 3.1	Apply dimensions to drawings to communicate size information.	PLTW-IED	ELA.RST.11-12.3 MTH.G.MG.3	LA.12.1.6.k LA.12.3.2 MA.12.1.3.a MA 12.2.5.b	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 3.1.1	Measure and record linear distances using a scale to a precision of 1/16 inch and 1 mm.	PLTW-IED			
Sample Performance Indicator 3.1.2	Measure and record linear distances using a dial caliper to a precision of 0.001 inch.	PLTW-IED			
Sample Performance Indicator 3.1.3	Add and subtract U.S. standard and metric linear measurements.	PLTW-IED			
Benchmark 3.2	Manufacture parts where dimensional values are often converted from one standard unit to another.	PLTW-IED		MA.12.2.5.c	
Sample Performance Indicator 3.2.1	Convert linear distance measurements from inches to millimeters and vice versa.	PLTW-IED			
sample Performance Indicator 3.2.2	Determine the front view for a given object.	PLTW-IED			

Benchmark 3.3	Determine the amount of variation that can be measured depends on the precision of the measuring tool	PLTW-IED	MTH.N.Q.3	MA.12.1.4.a MA.12.2.5.b	
Sample Performance Indicator 3.3.1	Add and subtract U.S. standard and metric linear measurements.	PLTW-IED			
Sample Performance Indicator 3.3.2	Measure and record linear distances using a scale to a precision of 1/16 inch and 1 mm.	PLTW-IED			
Benchmark 3.4	Apply statistical analysis of measurements to help verify the quality of a design or process.	PLTW-IED	MTH.N.Q.1 MTH.S.ID.2	MA.12.4.1.b MA.12.2.5.b	
Sample Performance Indicator 3.4.1	Calculate the mean, mode, median, and range of a data set.	PLTW-IED			
Sample Performance Indicator 3.4.2	Convert linear distance measurements from inches to millimeters and vice versa.	PLTW-IED			
Benchmark 3.5	Construct graphics to communicate patterns in recorded data	PLTW-IED	ELA.WHST.11-12.6 ELA.SL.11-12.5 MTH.S.ID.2	LA.12.2.1.f LA.12.3.1.c MA.12.3.2.a MA.12.4.1.b	
Sample Performance Indicator 3.5.1	Apply linear dimensions to a multiview drawing.	PLTW-IED			
Sample Performance Indicator 3.5.2	Calculate the mean, mode, median, and range of a data set.	PLTW-IED			

Sample Performance Indicator 3.5.3	Create a histogram of recorded measurements showing data elements or class intervals, and frequency.	PLTW-IED			
Standard 4	Students will design and construct a complex 3-dimensional object	PLTW-IED			
Benchmark 4.1	Derive three-dimensional forms from two-dimensional shapes	PLTW-IED	MTH.G.GMD.4	MA.12.2.4.a	
Sample Performance Indicator 4.1.1	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-IED			
Sample Performance Indicator 4.1.2	Select an approach that meets or satisfies the constraints given in a design brief.	PLTW-IED			
Sample Performance Indicator 4.1.3	Create simple extruded solid Computer Aided Design (CAD) models from dimensioned sketches.	PLTW-IED			
Benchmark 4.2	Develop a physical model using the design process.	PLTW-IED	ELA.RST.11-12.3 MTH.G.MG.3	LA.12.1.6.k LA.12.3.2 MA.12.2.4.a MA.12.2.4.b SC.12.1.3.a SC.12.1.3.a	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 4.2.1	Create simple extruded solid Computer Aided Design (CAD) models from dimensioned sketches.	PLTW-IED			

sample Performance Indicator 4.2.2	Generate dimensioned multiview drawings from simple CAD models.	PLTW-IED			
sample Performance Indicator 4.2.3	Measure and Fabricate parts for a functional prototype from the CAD multiview drawings.	PLTW-IED			
Benchmark 4.3	Develop models to communicate and evaluate possible solutions.	PLTW-IED		MA.12.2.5.b SC.12.1.3.d SC.12.1.3.e	
Sample Performance Indicator 4.3.1	Measure and fabricate parts for a functional prototype from the CAD multiview drawings.	PLTW-IED			
Sample Performance Indicator 4.3.2	Assemble the product using the CAD modeling software.	PLTW-IED			
Benchmark 4.4	Observe geometric and numeric constraints which are used to define the shape and size of objects in Computer Aided Design (CAD) modeling systems	PLTW-IED	MTH.G.GMD.3	MA.12.2.4.a MA.12.2.4.b MA.12.2.5.b	
Sample Performance Indicator 4.4.1	Create simple extruded solid Computer Aided Design (CAD) models from dimensioned sketches.	PLTW-IED			
Sample Performance Indicator 4.4.2	Generate dimensioned multiview drawings from simple CAD models.	PLTW-IED			
Sample Performance Indicator 4.4.3	Measure and Fabricate parts for a functional prototype from the CAD multiview drawings.	PLTW-IED			

Benchmark 4.5	Use CAD modeling systems to quickly generate and annotate working drawings.	PLTW-IED	ELA.RST.11-12.3 MTH.G.GMD.3	LA.12.1.6.k LA.12.3.2 MA.12.2.4.a MA.12.2.4.b MA 12.2.5 b	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 4.5.1	Generate dimensioned multiview drawings from simple CAD models.	PLTW-IED			
Sample Performance Indicator 4.5.2	Measure and fabricate parts for a functional prototype from the CAD multiview drawings.	PLTW-IED			
Sample Performance Indicator 4.5.3	Assemble the product using the CAD modeling software.	PLTW-IED			
		PLTW-IED			
Benchmark 4.6	Develop a packaging design to add aesthetic appeal, product production, and increase marketability.	PLTW-IED	ELA.WHST.11-12.6	LA.12.2.1.f	
Sample Performance Indicator 4.6.1	Apply geometric and numeric constraints to CAD sketches.	PLTW-IED			
Sample Performance Indicator 4.6.2	Identify the purpose of packaging in the design of consumer products.	PLTW-IED			
Standard 5	Students will be introduced to geometric shapes and solids.	PLTW-IED			

Benchmark 5.1	Identify geometric shapes and describe the two or three dimensional contours that characterize an object	PLTW-IED	ELA.WHST.11-12.2.b ELA.SL.11-12.4 MTH.G.MG.3	LA.12.2.1.b LA.12.3.1.a MA.12.2.4.a MA.12.2.4.b	When students describe, explain, or summarize information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-
Sample Performance Indicator 5.1.1	Identify common geometric shapes and forms by name.	PLTW-IED			
Sample Performance Indicator 5.1.2	Calculate the area of simple geometric shapes. Calculate the surface area and volume of simple geometric forms.	PLTW-IED			
		PLTW-IED			
Benchmark 5.2	Calculate properties of volume and surface area which are common to all designed objects and provide useful information	PLTW-IED	MTH.G.GMD.3	MA.12.2.5.c MA.12.2.5.f	Alignment presumes students will use the volume formula for cylinders, pyramids, cones or spheres (CC: MTH.G.MG.3; NE: MA.12.2.5.f).
Sample Performance Indicator 5.2.1	Calculate the area of simple geometric shapes.	PLTW-IED			
Sample Performance Indicator 5.2.2	Calculate the surface area and volume of simple geometric forms.	PLTW-IED			
Benchmark 5.3	Use CAD systems to increase productivity and reduce design costs	PLTW-IED	ELA.RST.11-12.3 MTH.G.MG.3	LA.12.1.6.k LA.12.3.2 MA.12.2.4.a MA.12.2.4.b	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 5.3.1	Apply geometric and numeric constraints to CAD sketches.	PLTW-IED			

Sample Performance Indicator 5.3.2	Utilize sketch-based, work reference, and placed features to develop solid CAD models from dimensioned drawings	PLTW-IED			
Benchmark 5.4	Create solid CAD models using both additive and subtractive processes.	PLTW-IED	ELA.RST.11-12.3 MTH.G.MG.3	LA.12.1.6.k LA.12.3.2 MA.12.2.4.a MA.12.2.4.b	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 5.4.1	Apply geometric and numeric constraints to CAD sketches.	PLTW-IED			
sample Performance Indicator 5.4.2	Utilize sketch-based, work reference, and placed features to develop solid CAD models from dimensioned drawings	PLTW-IED			
Standard 6	Students will develop a knowledge of dimensioning and tolerances	PLTW-IED			
Standard 8	Choose a problem design brief and create a solution for the problem.	PLTW-IED			
Benchmark 6.1	Create working drawings that should contain only the dimensions that are necessary to build and inspect an object.	PLTW-IED	ELA.RST.11-12.3 MTH.N.Q.2	LA.12.1.6.k LA.12.3.2 MA.12.2.4.a MA.12.2.4.b	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 6.1.1	Explain the differences between size and location dimensions.	PLTW-IED			

Sample Performance Indicator 6.1.2	Differentiate between datum dimensioning and chain dimensioning.	PLTW-IED			
Sample Performance Indicator 6.1.3	Identify and dimension fillets, rounds, diameters, chamfers, holes, slots, and screw threads in orthographic projection drawings.	PLTW-IED			
Benchmark 6.2	Create object features requiring specialized dimensions and symbols to communicate technical information, such as size.	PLTW-IED	ELA.RST.11-12.3	LA.12.1.6.k LA.12.3.2 MA.12.2.4.a MA.12.2.4.b	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 6.2.1	Explain the rules that are associated with the application of dimensions to multiview drawings.	PLTW-IED			
Sample Performance Indicator 6.2.2	Identify, sketch, and explain the difference between general tolerances, limit dimensions, unilateral, and bilateral tolerances.	PLTW-IED			
Benchmark 6.3	Consider tolerances that indicate the amount of dimensional variation that may occur without adversely affecting an object's function.	PLTW-IED	MTH.N.Q.3		
Sample Performance Indicator 6.3.1	Explain the rules that are associated with the application of dimensions to multiview drawings.	PLTW-IED			

Sample Performance Indicator 6.3.2	Differentiate between clearance and interference fits.	PLTW-IED			
Benchmark 6.4	Understand tolerances for mating part features are determined by the type of fit.	PLTW-IED			
Sample Performance Indicator 6.4.1	Identify, sketch, and explain the difference between general tolerances, limit dimensions, unilateral, and bilateral tolerances	PLTW-IED			
Sample Performance Indicator 6.4.2	Differentiate between clearance and interference fits.	PLTW-IED			
Standard 7	Students will document Advanced Modeling Skills	PLTW-IED			
Benchmark 7.1	Use CAD models, assemblies, and animations to check for design problems, verify the functional qualities of a design, and communicate information to other professionals and clients	PLTW-IED	ELA.WHST.11-12.6 ELA.SL.11-12.5 MTH.G.MG.3	LA.12.2.1.f LA.12.3.1.c MA.12.2.4.a MA.12.2.4.b	
Sample Performance Indicator 7.1.1	Sketch and model an auxiliary view of a given object to communicate the true size and shape of its inclined surface	PLTW-IED			

Sample Performance Indicator 7.1.2	Describe the purpose and demonstrate the application of section lines and cutting plane lines in a section view drawing	PLTW-IED			
Sample Performance Indicator 7.1.3	Sketch a full and half section view of a given object to communicate its interior features.	PLTW-IED			
Benchmark 7.2	Develop auxiliary views to communicate information about an object's inclined surfaces that appear foreshortened in basic multiview drawings	PLTW-IED	MTH.G.MG.3	MA.12.2.4.a MA.12.3.1.a	
Sample Performance Indicator 7.2.1	Sketch a full and half section view of a given object to communicate its interior features.	PLTW-IED			
sample Performance Indicator 7.2.2	Identify algebraic relationships between the dimensional values of a given object.	PLTW-IED			
Benchmark 7.3	Design sectional views to communicate an object's interior features that may be difficult to visualize from the outside	PLTW-IED	MTH.G.MG.3	MA.12.2.4.a	
Sample Performance Indicator 7.3.1	Describe the purpose and demonstrate the application of section lines and cutting plane lines in a section view drawing	PLTW-IED			

Sample Performance Indicator 7.3.2	Sketch a full and half section view of a given object to communicate its interior features.	PLTW-IED			
Benchmark 7.4	Utilize mathematical formulas to establish geometric and functional relationships within their designs.	PLTW-IED	MTH.G.GPE.7 MTH.G.GMD.3 MTH.G.MG.3	MA.12.2.2.c MA.12.2.4.b MA.12.2.5.a	Alignment presumes that students will use coordinates within their designs, and use those coordinates to compute perimeter and area of shapes (CC:G.GPE.7), and will calculate the surface area and volume of their designed objects (NE:12.2.5.a; CC: MTH.G.GMD.3)
Sample Performance Indicator 7.4.1	Identify algebraic relationships between the dimensional values of a given object.	PLTW-IED			
Benchmark 7.5	Create a parts list and balloons to identify individual components in an assembly drawing.	PLTW-IED			
Sample Performance Indicator 7.5.1	Create an exploded model of a given assembly.	PLTW-IED			
Sample Performance Indicator 7.5.2	Create and describe the purpose of the following items: exploded isometric assembly view, balloons, and parts list.	PLTW-IED			
Benchmark 8.1	Select a design brief to explain the problem, identify solution expectations, and establish project constraints.	PLTW-IED	ELA.WHST.11-12.9	LA.12.1.6.f SC.12.1.3.e	
Sample Performance Indicator 8.1.1	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-IED			

Sample Performance Indicator 8.1.2	Create a decision making matrix.	PLTW-IED			
Sample Performance Indicator 8.1.3	Select an approach that meets or satisfies the constraints given in a design brief.	PLTW-IED			
Benchmark 8.2	Utilize teamwork and constant communication to achieve the goal at hand.	PLTW-IED	ELA.SL.11-12.1	LA.12.3.3	
Sample Performance Indicator 8.2.1	Create a decision making matrix.	PLTW-IED			
sample Performance Indicator 8.2.2	Select an approach that meets or satisfies the constraints given in a design brief.	PLTW-IED			
Benchmark 8.3	Conduct research to develop their knowledge base, stimulate creative ideas, and make informed	PLTW-IED	ELA.WHST.11-12.7-9	LA.12.1.6.j LA.12.4.1.a-c	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7–9; NE: LA.12.1.6.j,
Sample Performance Indicator 8.3.1	Select an approach that meets or satisfies the constraints given in a design brief.	PLTW-IED			
Sample Performance Indicator 8.3.2	Brainstorm and sketch possible solutions to an existing design problem.	PLTW-IED			

Benchmark 8.4	Utilize computer-aided design (CAD) modeling systems to quickly generate and annotate working drawings.	PLTW-IED	ELA.RST.11-12.3 MTH.G.GPE.7 MTH.G.MG.3	LA.12.1.6.k LA.12.3.2 MA.12.2.4.b	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2). Alignment presumes that students will determine the appropriate coordinates for their drawings using the distance formula (CC: MTH.G.GPE.7).
Sample Performance Indicator 8.4.1	Create solid computer-aided design (CAD) models of each part from dimensioned sketches using a variety of methods	PLTW-IED			
Sample Performance Indicator 8.4.2	Apply geometric numeric and parametric constraints to form CAD modeled parts.	PLTW-IED			
Sample Performance Indicator 8.4.3	Generate dimensioned multiview drawings from simple CAD modeled parts.	PLTW-IED			
Benchmark 8.5	Identify fluid power, hydraulics and pneumatics as an enhancement to solving problems with electrical control systems	PLTW-IED			
Sample Performance Indicator 8.5.1	Explain the concept of fluid power, and the difference between hydraulic and pneumatic power systems	PLTW-IED			

Sample Performance Indicator 8.5.2	Create a three-fold brochure marketing the designed solution for the chosen problem, such as a consumer product, a dispensing system, a new form of control system, or extend a product design to meet a new requirement.	PLTW-IED			
Standard 9	Students will analyze and talk about a product or object using the language of design.	PLTW-IED			
Benchmark 9.1	Students will design and identify aesthetic appeal results from the interplay between design principles and elements.	PLTW-IED		SC.12.1.3.a SC.12.1.3.c SC.12.1.3.d SC.12.1.3.e	
Sample Performance Indicator 9.1.1	Identify visual design elements within a given object.	PLTW-IED			
Sample Performance Indicator 9.1.2	Explain how visual design principles were used to manipulate design elements within a given object.	PLTW-IED			
Sample Performance Indicator 9.1.3	Explain what aesthetics is, and how it contributes to a design's commercial success.	PLTW-IED			

Benchmark 9.2	Investigate the differences between functional and structural requirements.	PLTW-IED	ELA.WHST.11-12.7-9	LA.12.1.6.j LA.12.4.1.a-c	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7–9; NE: LA.12.1.6.j, LA.12.4.1.a-c)
Sample Performance Indicator 9.2.1	Identify visual design principles and elements that are present within marketing ads.	PLTW-IED			
sample Performance Indicator 9.2.2	Explain what aesthetics is, and how it contributes to a design's commercial success.	PLTW-IED			
Benchmark 9.3	Describe how visual appeal influences a design's commercial success.	PLTW-IED	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a	When students describe information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Sample Performance Indicator 9.3.1	Identify the purpose of packaging in the design of consumer products.	PLTW-IED			
Sample Performance Indicator 9.3.2	Identify the intent of a given marketing ad and demographics of the target consumer group for which it was intended.	PLTW-IED			
Benchmark 9.4	Develop visual messages that make people in a target audience respond in a predictable and favorable manner.	PLTW-IED	ELA.SL.11-12.5 MTH.G.MG.3	LA.12.3.1.c MA.12.2.4.b	

Sample Performance Indicator 9.4.1	Identify visual design principles and elements that are present within marketing ads.	PLTW-IED			
Sample Performance Indicator 9.4.2	Apply geometric numeric and parametric constraints to form CAD modeled parts.	PLTW-IED			
Sample Performance Indicator 9.4.3	Identify the intent of a given marketing ad and demographics of the target consumer group for which it was intended.	PLTW-IED			
Standard 10	Students will use reverse engineering to discover how unique parts are constructed to optimize manufacturing potential and increase a company's profit margin.	PLTW-IED			
Benchmark 10.1	Perform reverse engineering on products to study their visual, functional, and structural qualities.	PLTW-IED			
Sample Performance Indicator 10.1.1	Identify the reasons why engineers perform reverse engineering on products.	PLTW-IED			
Sample Performance Indicator 10.1.2	Describe the function of a given manufactured object as a sequence of operations through visual analysis and inspection (prior to dissection)	PLTW-IED			

Benchmark 10.2	Through observation and analysis, students divide a product's function into a sequence of operations.	PLTW-IED			
Sample Performance Indicator 10.2.1	Describe the function of a given manufactured object as a sequence of operations through visual analysis and inspection (prior to dissection)	PLTW-IED			
Benchmark 10.3	Describe products that operate as systems, with identifiable inputs and outputs.	PLTW-IED	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a	When students describe information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Sample Performance Indicator 10.3.1	Describe the function of a given manufactured object as a sequence of operations through visual analysis and inspection (prior to dissection)	PLTW-IED			
Standard 11	Study various joints, fasteners, and adhesives will allow greater insight into the manufacturing process used to produce products.	PLTW-IED			

Benchmark 11.1	Describe the various objects are held together by means of joinery, fasteners, or adhesives.	PLTW-IED	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a	When students describe information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Sample Performance Indicator 11.1.1	Describe the differences between joinery, fasteners, and adhesives.	PLTW-IED			
Sample Performance Indicator 11.1.2	Identify the types of structural connections that exist in a given object.	PLTW-IED			
Benchmark 11.2	Operate precision measurement tools and techniques are used to accurately record an object's geometry.	PLTW-IED	ELA.RST.11-12.3 MTH.N.Q.3	LA.12.1.6.k LA.12.3.2 MA.12.2.5.b	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 11.2.1	Use dial calipers to precisely measure outside and inside diameter, hole depth, and object thickness.	PLTW-IED			
Sample Performance Indicator 11.2.2	Identify a given object's material type.	PLTW-IED			
Benchmark 11.3	Identify operational conditions, material properties, and manufacturing methods help engineers determine the material makeup of a design.	PLTW-IED			

Sample Performance Indicator 11.3.1	Identify a given object's material type.	PLTW-IED			
Sample Performance Indicator 11.3.2	Identify material processing methods that are used to manufacture the components of a given commercial product	PLTW-IED			
Benchmark 11.4	Utilize reference sources and computer-aided design (CAD) systems to calculate the mass properties of designed objects	PLTW-IED	ELA.RST.11-12.7 MTH.G.MG.2	LA.12.4.1.a MA.12.2.4.b MA.12.2.5.c MA.12.2.5.f	
Sample Performance Indicator 11.4.1	Assign a density value to a material, and apply it to a given solid CAD model.	PLTW-IED			
sample Performance Indicator 11.4.2	Perform computer analysis to determine mass, volume, and surface area of a given object.	PLTW-IED			
Benchmark 11.5	Determine volume, surface area, density, and mass properties of a product.	PLTW-IED	MTH.G.GMD.3 MTH.G.MG.2 MTH.G.MG.3	MA.12.2.4.b MA.12.2.5.c MA.12.2.5.f	Alignment presumes that students will use the volume formulas for cylinders, pyramids, cones, or spheres (CC:MTH.G.GMD.3).
Sample Performance Indicator 11.5.1	Assign a density value to a material, and apply it to a given solid CAD model.	PLTW-IED			
Sample Performance Indicator 11.5.2	Perform computer analysis to determine mass, volume, and surface area of a given object.	PLTW-IED			

Standard 12	Students will identify visual, structural, or functional issues for product Improvement by design.	PLTW-IED			
Benchmark 12.1	Analyze designs to identify shortcomings and opportunities for innovation.	PLTW-IED	ELA.RST.11-12.8	LA.12.1.6.a SC.12.1.3.a	
Sample Performance Indicator 12.1.1	Write design briefs that focus on product innovation.	PLTW-IED			
Benchmark 12.2	Use brainstorming techniques to generate large numbers of ideas in short time periods (in teams)	PLTW-IED	ELA.L.11-12.1	LA.12.3.3 SC.12.1.3.a	
Sample Performance Indicator 12.2.1	Identify and apply group brainstorming techniques and the rules associated with brainstorming.	PLTW-IED			
Benchmark 12.3	Use decision matrices to help make design decisions that are based on analysis and logic.	PLTW-IED		SC.12.1.3.a	
Sample Performance Indicator 12.3.1	Apply decision matrices to make design decisions.	PLTW-IED			
Benchmark 12.4	Write technical reports to explain project information to various audiences.	PLTW-IED	ELA.WHST.11.12.2	LA.12.2.2 SC.12.1.3.e	

Sample Performance Indicator 12.4.1	Explain the difference between invention and innovation.	PLTW-IED			
Standard 13	Students will explore ethical issues that are considered when deciding on a workable solution to a design or solution to a problem	PLTW-IED			
Benchmark 13.1	Identify material of a product, how the material is prepared for use, its durability, and ease of recycling all impact a product's design, marketability, and life expectancy.	PLTW-IED	ELA.RST.11-12.4	LA.12.1.5 SC.12.4.3.c	
Sample Performance Indicator 13.1.1	Create a brainstorming list of different products made from common materials that are used daily.	PLTW-IED			
Sample Performance Indicator 13.1.2	Research and construct a product impact timeline presentation of a product from the brainstorming list and present how the product may be recycled and used to make other products after its lifecycle is complete.	PLTW-IED			
Benchmark 13.2	Consider human and global impacts of various manufacturing process options.	PLTW-IED		SC.12.4.2.c	

Sample Performance Indicator 13.2.1	Research and construct a product impact timeline presentation of a product from the brainstorming list and present how the product may be recycled and used to make other products after its lifecycle is complete	PLTW-IED			
sample Performance Indicator 13.2.2	Create a brainstorming list of different products made from common materials that are used daily.	PLTW-IED			
Benchmark 13.3	Investigate the recyclable uses of materials as it will play a vital role in the future of landfills and the environment	PLTW-IED	ELA.WHST.11-12.7-9	LA.12.1.6.j LA.12.4.1.a-c SC.12.4.3.c	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.11-12.7–9; NE: LA.12.1.6.j, LA.12.4.1.a–c).
Sample Performance Indicator 13.3.1	Research and construct a product impact timeline presentation of a product from the brainstorming list and present how the product may be recycled and used to make other products after its lifecycle is complete	PLTW-IED			
Sample Performance Indicator 13.3.2	Identify the five steps of a product's lifecycle and investigate and propose recyclable uses for the material once the lifecycle of the product is complete	PLTW-IED			
Standard 14	Students will work in design teams.	PLTW-IED			

Benchmark 14.1	Design teams establish group norms through brainstorming and consensus to regulate proper and acceptable behavior by and between team members.	PLTW-IED	ELA.SL.11-12.1	LA.12.3.3	
Sample Performance Indicator 14.1.1	Explain why teams of people are used to solve problems.	PLTW-IED			
Sample Performance Indicator 14.1.2	Identify group norms that allow a virtual design team to function efficiently.	PLTW-IED			
Benchmark 14.2	Develop Gantt charts to plan, manage, and control a design team's actions on projects that have definite beginning and end dates.	PLTW-IED	ELA.SL.11-12.1.b		
Sample Performance Indicator 14.2.1	Establish file management and file revision protocols to ensure the integrity of current information.	PLTW-IED			
Sample Performance Indicator 14.2.2	Use internet resources, such as email, to communicate with a virtual design team member throughout a design challenge.	PLTW-IED			
Benchmark 14.3	Demonstrate communications other than face-to-face contact to work effectively to solve problems.	PLTW-IED		LA.12.4.1.d LA.12.4.1.f-g	

Sample Performance Indicator 14.3.1	Use internet resources, such as email, to communicate with a virtual design team member throughout a design challenge	PLTW-IED			
Sample Performance Indicator 14.3.2	Identify group norms that allow a virtual design team to function efficiently.	PLTW-IED			
Benchmark 14.4	Resolve conflict between team members is a normal occurrence, and can be addressed using formal conflict resolution strategies.	PLTW-IED	ELA.SL.11-12.1.b-d	LA.12.3.3.b	
Sample Performance Indicator 14.4.1	Identify strategies for addressing and solving conflicts that occur between team members.	PLTW-IED			
Sample Performance Indicator 14.4.2	Create a Gantt chart to manage the various phases of their design challenge.	PLTW-IED			